

# Homework set 3:

## Challenging Factor Label Problems

1. When 121g of sulfuric acid are added to  $4.00 \times 10^2 \text{ mL}$  of water (at  $4^\circ\text{C}$ ), the resulting solutions volume is 437mL. What is the density of the resulting solution?

$$\text{Density of solution} = \frac{\text{mass}_{\text{sulfuric}} + \text{mass}_{\text{water}}}{\text{volume of solution}}$$

Most elegant solution ☺

$$\frac{121\text{g} + \left( \frac{1.00\text{g}}{\text{mL}} \left( \frac{4.00 \times 10^2 \text{mL}}{1} \right) \right)}{437\text{mL}} = 1.9122... \rightarrow \boxed{1.91 \frac{\text{g}}{\text{mL}}}$$

2. The density of dry air at  $20^\circ\text{C}$  is  $1.20\text{g/L}$ . What is the mass of air, in kilograms, in a rectangular room that measures  $25.0\text{m} \times 15.0\text{m} \times 4.0\text{m}$ ? *Given*

$$D = \frac{m}{V} \quad m = DV$$

$$\begin{aligned} D &= 1.20\text{g/L} \\ V &= 25.0\text{m} \times 15.0\text{m} \times 4.0\text{m} \end{aligned}$$

$$\underbrace{\frac{1.20\text{g}}{\text{L}} \left( \frac{1\text{L}}{1000\text{cm}^3} \right)}_{\text{density } \frac{\text{g}}{\text{m}^3}} \underbrace{\left( \frac{100\text{cm}}{1\text{m}} \right)^3 \left( \frac{25.0\text{m} \times 15.0\text{m} \times 4.0\text{m}}{1} \right)}_{\text{volume}} \underbrace{\left( \frac{1\text{Kg}}{1000\text{g}} \right)}_{\text{mass conversion}} = \boxed{1800\text{Kg}}$$

3. Indiana Jones, at the beginning of the Raiders of the Lost Ark, finds an ancient solid gold idol in a South American jungle cave. The idol appears to have a volume of 1.5L. What weight of sand in pounds would Indiana Jones need in order to replace the idol on its booby-trapped pedestal? What volume in Liters is the sand? *density of sand =  $1.7\text{g/mL}$*

$$D = \frac{m}{V} \quad m = DV$$

weight of sand (lb)

$$\underbrace{\frac{19.3\text{g}}{\text{mL}} \left( \frac{1000\text{mL}}{1\text{L}} \right) \left( \frac{1\text{Kg}}{1000\text{g}} \right) \left( \frac{2.2\text{lb}}{1\text{Kg}} \right)}_{\text{Density converted to lb/L (gold)}} \underbrace{\left( \frac{1.5\text{L}}{1} \right)}_{\text{volume of gold}} = 63.69 \rightarrow \boxed{64\text{lbs}}$$

\*The mass of gold must equal the mass of sand to replace the idol.

I will show you the video clip on Monday.

Volume of sand (L)  $D = \frac{m}{V} \quad V = \frac{m}{D}$  density

$$\underbrace{\frac{19.3\text{g}}{\text{mL}} \left( \frac{1000\text{mL}}{1\text{L}} \right)}_{\text{mass}} \underbrace{\left( \frac{1.5\text{L}}{1} \right) \left( \frac{1\text{mL}}{1.7\text{g}} \right) \left( \frac{1\text{L}}{1000\text{mL}} \right)}_{\text{mass of gold = mass of sand}} = 17.029... \rightarrow 17\text{L}$$

4. A farmer raised 50 goats. He went to the marketplace with \$100.00 and traded the goats for sheep at a rate of 5 goats for every sheep. Then he traded the sheep for hogs at a rate of 4 sheep for 2 hogs each weighing 250 lbs. Finally, he traded the hogs for the going rate of \$55.00 per 100 lbs. How much money did the farmer take home?

<u>Given</u>	<u>Find</u>	<u>Useful info</u>
50 goats \$100	\$	$4 \text{ sheep} = 2 \text{ hogs}$ $1 \text{ sheep} = 5 \text{ goats}$ $1 \text{ hog} = 250 \text{ lb.}$ $\$55.00 = 100 \text{ lb.}$

$$50 \text{ goats} \left( \frac{1 \text{ sheep}}{5 \text{ goats}} \right) \left( \frac{2 \text{ hogs}}{4 \text{ sheep}} \right) \left( \frac{250 \text{ lb}}{1 \text{ hog}} \right) \left( \frac{\$55.00}{100 \text{ lb}} \right) = \$687.50 + 100.00 = \$787.50$$

in pocket from start

5. A student measures a spherical balloon with a string and determines its circumference to be 64.0 cm. The balloon happens to be filled with CO<sub>2</sub> gas. Calculate the following:

(a) The volume of the balloon in m<sup>3</sup>.

(b) The mass of the balloon in pounds.

(The density of CO<sub>2</sub> is 1.80g/L; circumference =  $\pi d$ ;  $r = \frac{1}{2} d$ ;  $V_{\text{sphere}} = \frac{4}{3} \pi r^3$ )

6. Chlorine is the most abundant element in seawater. Normal seawater has a density of 1.0 g/mL and contains 19,000mg of chlorine per liter. How much chlorine (in kg) is in a sample of seawater that has a mass of 1580g?